

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3430U20-1



S23-3430U20-1

FRIDAY, 16 JUNE 2023 – MORNING

SCIENCE (Double Award)
Unit 2 – CHEMISTRY 1
FOUNDATION TIER

1 hour 15 minutes

ADDITIONAL MATERIALS

In addition to this examination paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	9	
3.	9	
4.	8	
5.	6	
6.	5	
7.	8	
8.	7	
Total	60	

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Answer **all** questions.

1. (a) The table shows four compounds and their formulae.

Compound	Formula
nitrogen dioxide	NO_2
hydrogen bromide	HBr
ethane	C_2H_6
ammonia	NH_3

Use the information in the table to answer the following questions.

- (i) Give the **name** of the compound that contains the elements hydrogen and bromine. [1]

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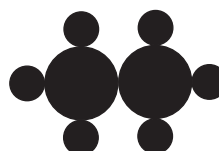
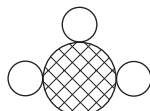
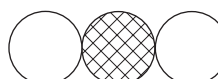
- (ii) Give the **names** of the elements present in ethane. [1]

..... and

- (iii) Give the **total** number of atoms found in a molecule of nitrogen dioxide. [1]

.....

- (iv) Tick (✓) the box next to the diagram that represents a molecule of ammonia, NH_3 . [1]


☐

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- (b) Some ants spray a toxic mixture containing formic acid to defend themselves from predators.

Each molecule of formic acid contains two atoms of hydrogen, one atom of carbon and two atoms of oxygen.

Use this information to give the formula of formic acid. [1]

.....

- (c) The box contains the names of three compounds that are made from positive and negative ions.

lithium chloride	magnesium bromide	calcium oxide
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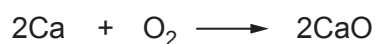
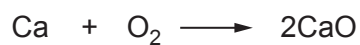
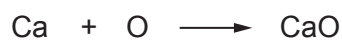
- (i) Give the formulae of the **ions** present in lithium chloride. [1]

..... and

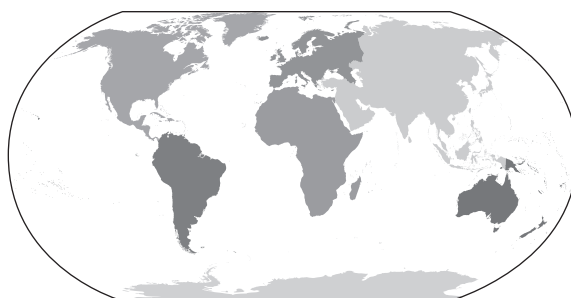
- (ii) Give the formula of magnesium bromide. [1]

.....

- (iii) Tick (✓) the box next to the correct equation for the reaction between calcium and oxygen to produce calcium oxide. [1]


☐

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2. The diagram shows how the Earth's continents are arranged today.



In 1912, Alfred Wegener proposed the theory of continental drift.

- (a) (i) Use statements from the table to answer parts I. and II. below.

A	there are similar animals on different continents
B	there are similar fossils on different continents
C	only Europe, Asia and Africa were once joined
D	all of the continents were once joined
E	there is a jigsaw fit of different continents
F	there are similar rocks on different continents
G	none of the continents were joined

- I. Give the **letter** of the statement that describes how Wegener suggested the continents were originally arranged. [1]

.....

- II. Give the **letters of three** pieces of evidence that Wegener used to support his theory. [3]

.....

- (ii) Underline the correct word in the brackets to complete the following sentence. [1]

Wegener could not explain how the continents moved but it is now known that this happens because of (**conduction** / **convection** / **radiation**) currents in the Earth's mantle.



- (b) The table shows how the mean temperature of the Earth's atmosphere has increased between 1960 and 2010.

Year	Mean temperature (°C)
1960	13.9
1970	14.0
1980	14.2
1990	14.3
2000	14.4
2010	14.6

- (i) Underline the mean temperature of the Earth's atmosphere in 2020 if this trend continued. [1]

15.0 14.4 14.8

- (ii) Name the gas which is mainly responsible for the temperature increase. [1]

.....

- (iii) Give **two** effects of global warming. [2]

.....



3. The table shows how the solubility of potassium nitrate in water varies with temperature.

Temperature (°C)	Solubility (g per 100g of water)
0	13
10	21
20	32
30	46
40	64
50	86

- (a) Tick (✓) the box that shows approximately how many times more soluble potassium nitrate is at 40 °C than it is at 10 °C. [1]

2 times

☐

3 times

☐

4 times

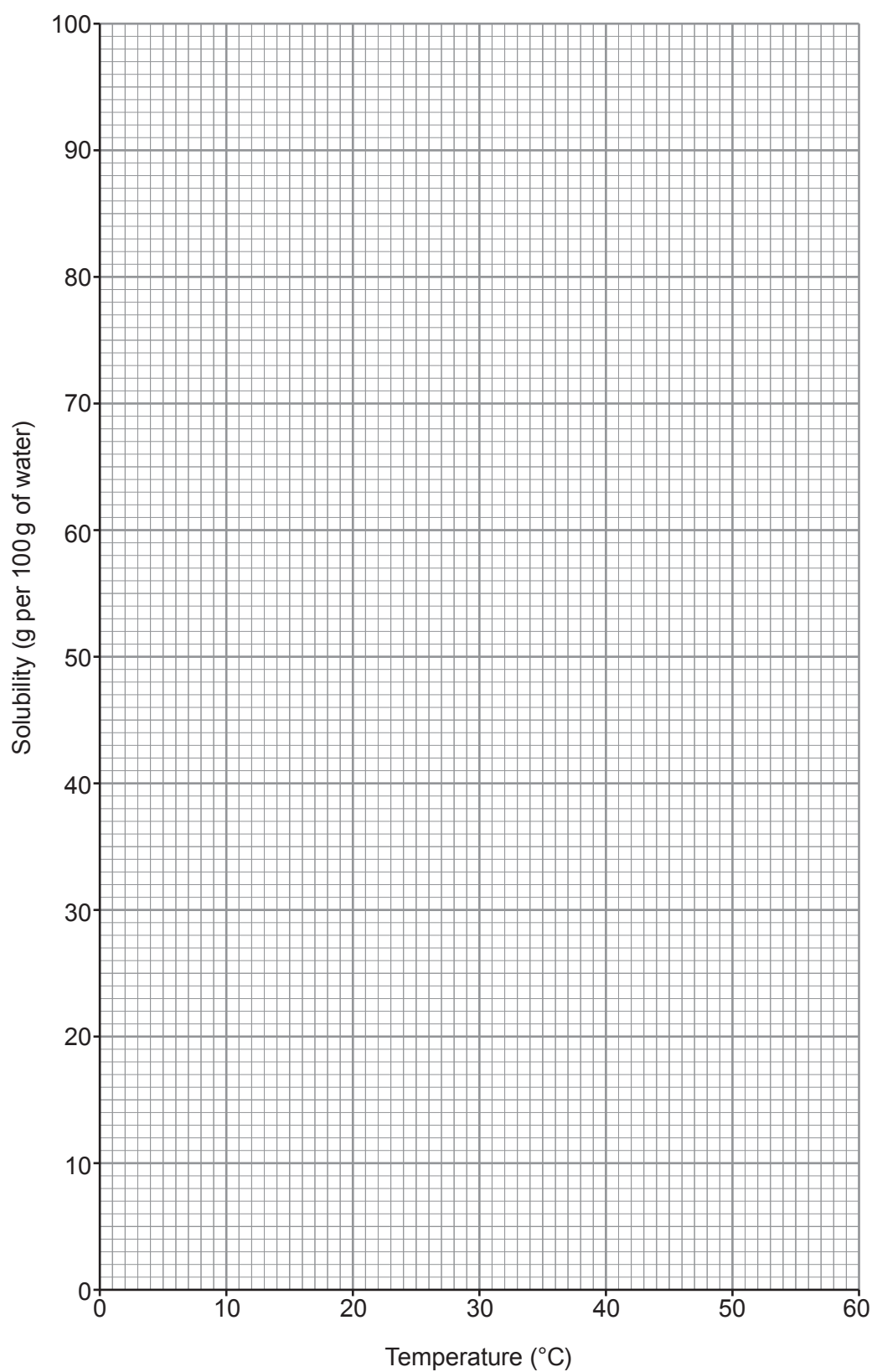
☐

5 times

☐

- (b) (i) Plot the solubility of potassium nitrate against temperature on the grid.
Draw a suitable line.

[3]



- (ii) I. State the solubility of potassium nitrate at 45 °C. [1]

..... g per 100 g of water

- II. Calculate the mass of solid potassium nitrate that forms when a saturated solution in 100 g of water at 45 °C cools to 25 °C. [1]

Mass = g

- (c) Potassium nitrate decomposes on heating to produce potassium nitrite, KNO_2 , and oxygen.

- (i) Balance the equation for the reaction. [1]



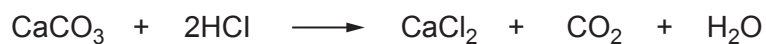
- (ii) On heating potassium nitrate, a student expected to make 4.35 g of potassium nitrite. However, in an experiment she only made 3.13 g.

Calculate the percentage yield of potassium nitrite in her experiment. Give your answer to the nearest **whole** number. [2]

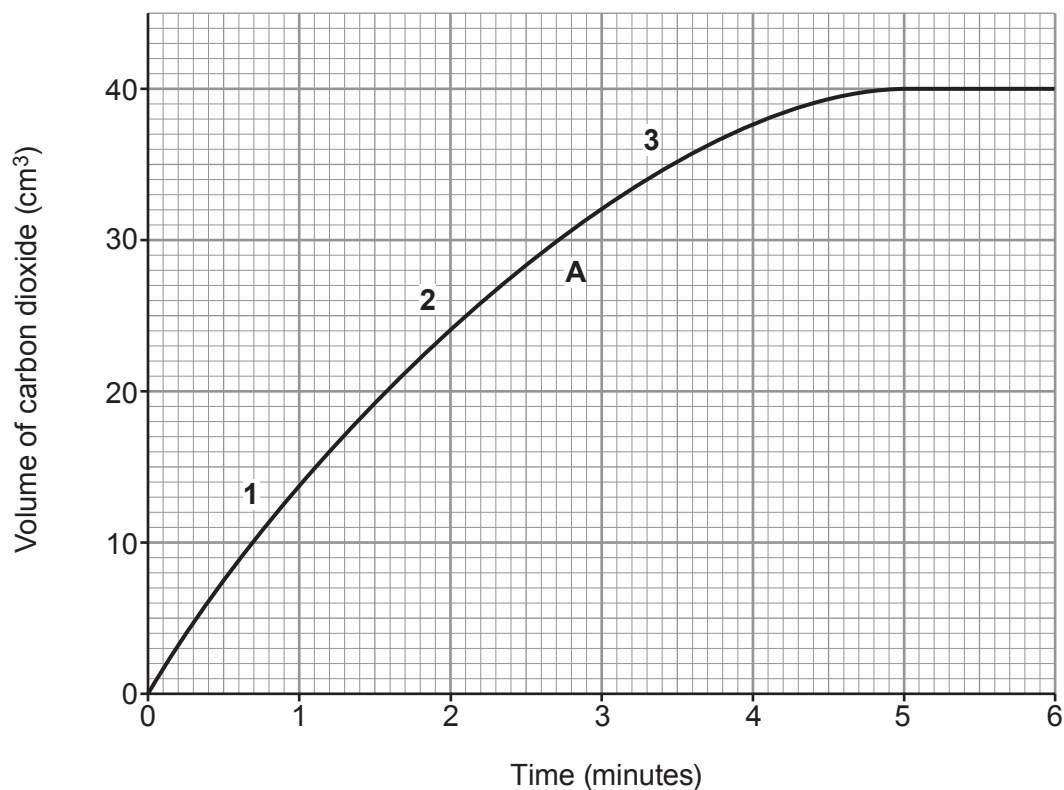
Percentage yield = %



4. Marble chips (calcium carbonate) react with hydrochloric acid to produce carbon dioxide gas as shown in the equation.



Graph **A** shows the volume of carbon dioxide produced over 6 minutes when the reaction was carried out at 30 °C.



- (a) (i) Find the volume of carbon dioxide given off after 2 minutes. [1]

..... cm³

- (ii) Find the time taken for the reaction to finish. [1]

..... minutes

- (iii) At which of the following points on graph **A** is the reaction at its fastest? [1]

Tick (✓) the correct box.

1

☐

2

☐

3

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- (iv) After $\frac{1}{2}$ minute, 7.5 cm^3 of carbon dioxide has been produced.

Use the equation to calculate the mean rate of reaction over this time in cm^3/s .

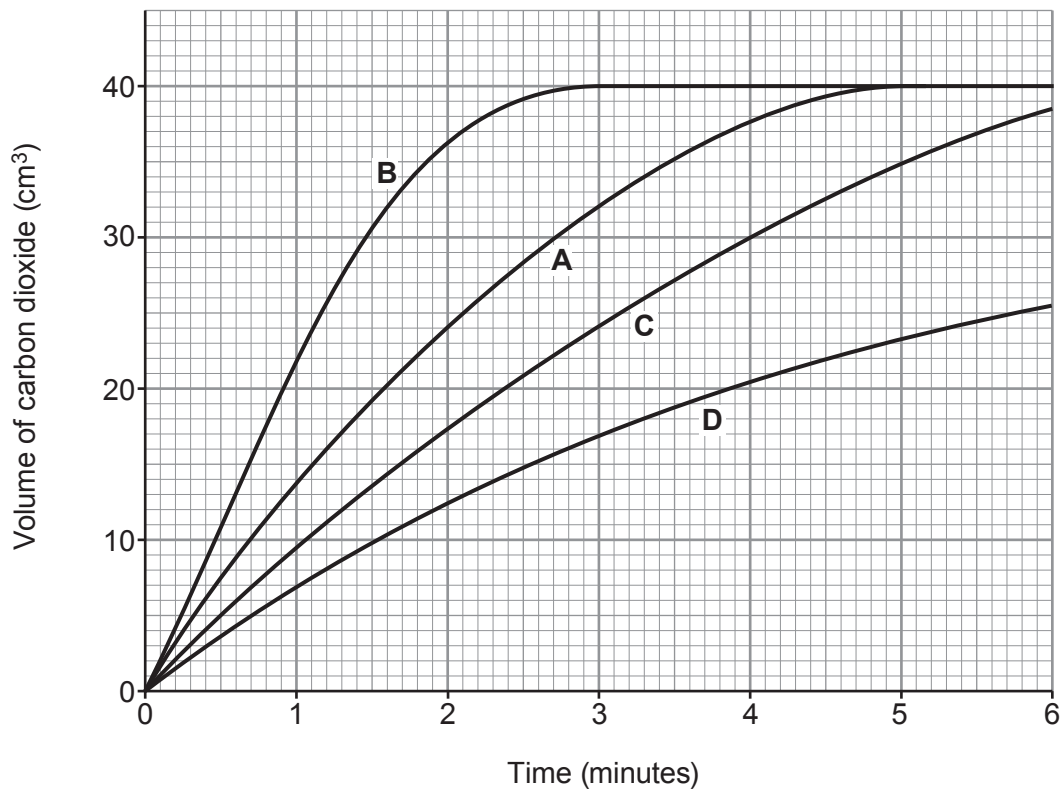
[2]

$$\text{mean rate} = \frac{\text{volume of carbon dioxide produced}}{\text{time (in seconds)}}$$

Mean rate = cm^3/s



- (b) (i) Graphs **B**, **C** and **D** on the grid below show the results for the experiment carried out at **different** temperatures. Graph **A** for the reaction carried out at 30 °C is also shown.



State which of graphs **B**, **C** and **D** shows the results for the experiment carried out at a temperature of 40 °C. [1]

Graph

- (ii) Using your knowledge of particle theory, underline the correct words in the brackets to complete the following sentence. [2]

At a higher temperature, the particles will have

(**more** / less / the same amount of) energy, so they will move faster and

there will be (an equal / a smaller / a greater) number of successful

collisions per second.



5. A teacher wanted to demonstrate the reactivity of lithium, sodium and potassium with water.

State what safety precautions the teacher should take and describe the observations you would expect for each metal.

You are **not** expected to include equations in your answer.

[6 QER]

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6. Fluoride ions (mostly from sodium fluoride) are found naturally in the drinking water in some regions of England. The concentration of these fluoride ions is quite low with values being less than 0.5 mg/dm^3 .

However, water companies in some areas add fluoride ions to drinking water. Areas where this happens include Yorkshire, the North East, the East Midlands and the West Midlands. The mean concentration of fluoride ions added is around 1 mg/dm^3 .

It is known that a high concentration of fluoride ions in drinking water can be poisonous and can cause a yellowing of teeth – fluorosis. Fluoridation of drinking water is a controversial issue. Some people are opposed to it because it removes the individual's choice to not take fluoride.

The table shows the mean number of decayed, missing and filled teeth (DMFT) in five-year-old children in some areas of England in 2018.

Area	Mean DMFT
South East	0.6
West Midlands	0.7
North West	1.3
London	1.0
South West	0.7
Yorkshire	1.0
North East	1.0
East Midlands	0.9
East England	0.7



- (a) Which **two** of the following statements are correct according to the information given?
Tick (✓) **two** boxes. [2]

London, Yorkshire and the North West all have a mean DMFT of 1.0

☐

The South East has the lowest mean DMFT

☐

The East Midlands has the highest mean DMFT

☐

East England, the South West and the South East have a mean DMFT of 0.7

☐

The East Midlands has a lower mean DMFT than Yorkshire

☐

London, the North West and the South West all have a mean DMFT of 0.9

☐

- (b) (i) Which of the following statements supports the argument for fluoridation of drinking water? Tick (✓) **one** box. [1]

All areas with fluoridated drinking water have lower mean DMFT than areas which do not fluoridate drinking water

☐

All areas with fluoridated drinking water have the same mean DMFT as non-fluoridated areas

☐

All areas with fluoridated drinking water have lower mean DMFT than the North West

☐

- (ii) Which of the following statements could be used to oppose the argument for fluoridation of drinking water? Tick (✓) **one** box. [1]

It is not possible to decide whether fluoridation of drinking water lowers mean DMFT

☐

All areas with fluoridated drinking water have higher mean DMFT than areas which do not fluoridate drinking water

☐

All areas with fluoridated drinking water have a higher mean DMFT than the South West

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- (c) Suggest a possible reason why the South East has a low mean DMFT in five-year-old children even though no fluoride is added to drinking water in this area. [1]

Examiner
only

5



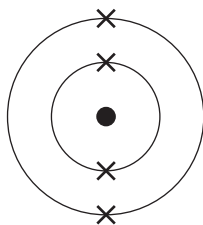
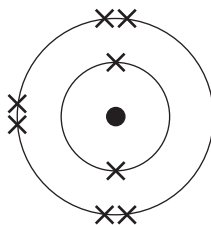
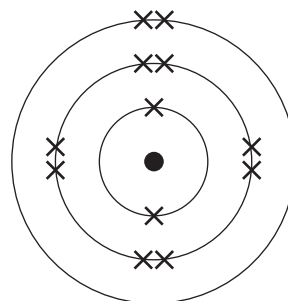
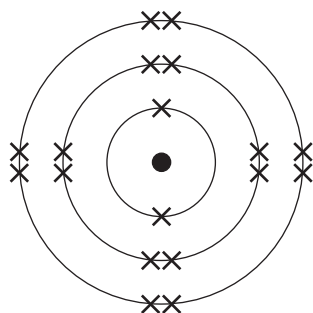
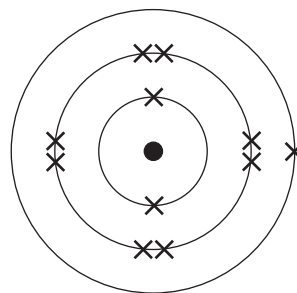
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7. The diagrams below show the electronic structures of five elements, **A**, **B**, **C**, **D** and **E**.

The letters are not the symbols of the elements.

**A****B****C****D****E**

- (a) Give the **letters** of the elements found in Period 2 of the Periodic Table. Give a reason for your choice. [2]

Letters and

Reason

.....



- (b) Give the **letter** of the element found in Group 0 of the Periodic Table. Give a reason for your choice. [2]

Letter

Reason

- (c) Explain how the electronic structure of element **E** can be used to determine its atomic number. [2]

.....

- (d) One of the diagrams represents the element oxygen. Oxygen reacts with potassium to form potassium oxide.

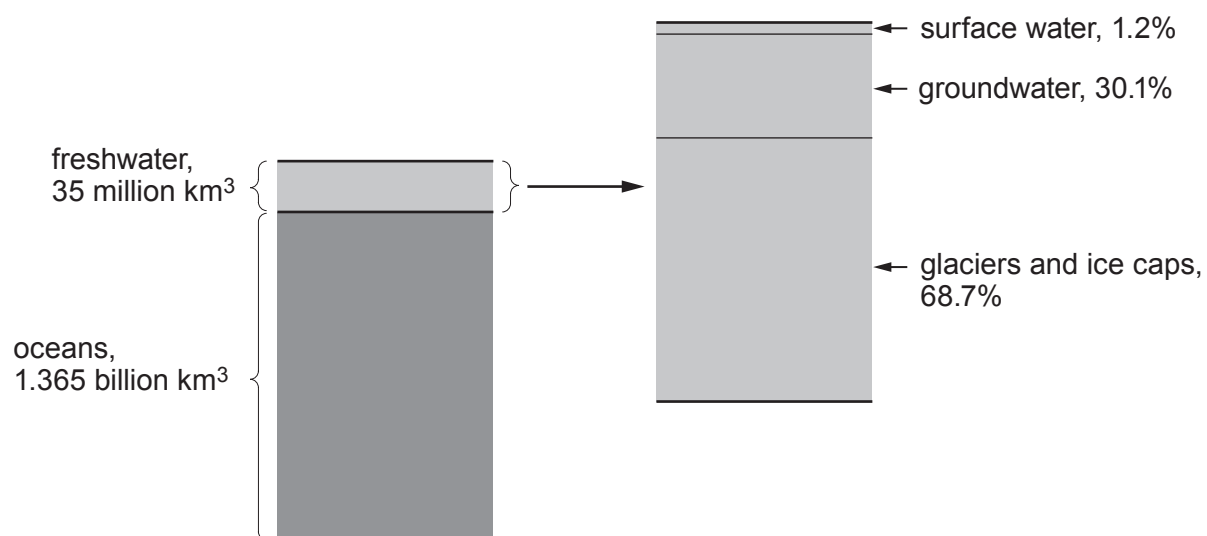
Give the formula for potassium oxide and balance the equation for this reaction. [2]



8



8. The diagram shows the distribution of water on Earth.



- (a) Use the information in the diagram to calculate the volume of freshwater that is available as surface water. [2]

Volume = million km³

- (b) As the Earth's population continues to increase, there is going to be a greater need to get freshwater from seawater. This is known as desalination.

Give a method that could be used to obtain freshwater from seawater. [1]

.....



- (c) Calcium ions, Ca^{2+} , cause hardness in groundwater.

Describe an experiment to **compare** the hardness of two groundwater samples. [3]

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- (d) Washing soda is used to soften hard water. This contains sodium carbonate.

Give the formula of sodium carbonate. [1]

.....

END OF PAPER

7



[illegible]

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	Formula	Name	Formula
aluminium	Al^{3+}	bromide	Br^-
ammonium	NH_4^+	carbonate	CO_3^{2-}
barium	Ba^{2+}	chloride	Cl^-
calcium	Ca^{2+}	fluoride	F^-
copper(II)	Cu^{2+}	hydroxide	OH^-
hydrogen	H^+	iodide	I^-
iron(II)	Fe^{2+}	nitrate	NO_3^-
iron(III)	Fe^{3+}	oxide	O^{2-}
lithium	Li^+	sulfate	SO_4^{2-}
magnesium	Mg^{2+}		
nickel	Ni^{2+}		
potassium	K^+		
silver	Ag^+		
sodium	Na^+		
zinc	Zn^{2+}		





THE PERIODIC TABLE

1 2 3 4 5 6 7 0

Group

<div>1 H Hydrogen 1</div>										<div>4 He Helium 2</div>																									
<div>7 Li Lithium 3</div>		<div>9 Be Beryllium 4</div>								<div>11 B Boron 5</div>		<div>12 C Carbon 6</div>		<div>14 N Nitrogen 7</div>		<div>16 O Oxygen 8</div>		<div>19 F Fluorine 9</div>		<div>20 Ne Neon 10</div>															
<div>23 Na Sodium 11</div>		<div>24 Mg Magnesium 12</div>										<div>27 Al Aluminium 13</div>		<div>28 Si Silicon 14</div>		<div>31 P Phosphorus 15</div>		<div>32 S Sulfur 16</div>		<div>35.5 Cl Chlorine 17</div>		<div>40 Ar Argon 18</div>													
<div>39 K Potassium 19</div>		<div>40 Ca Calcium 20</div>		<div>45 Sc Scandium 21</div>		<div>48 Ti Titanium 22</div>		<div>51 V Vanadium 23</div>		<div>52 Cr Chromium 24</div>		<div>55 Mn Manganese 25</div>		<div>56 Fe Iron 26</div>		<div>59 Co Cobalt 27</div>		<div>59 Ni Nickel 28</div>		<div>63.5 Cu Copper 29</div>		<div>65 Zn Zinc 30</div>		<div>70 Ga Gallium 31</div>		<div>73 Ge Germanium 32</div>		<div>75 As Arsenic 33</div>		<div>79 Se Selenium 34</div>		<div>80 Br Bromine 35</div>		<div>84 Kr Krypton 36</div>	
<div>86 Rb Rubidium 37</div>		<div>88 Sr Strontium 38</div>		<div>89 Y Yttrium 39</div>		<div>91 Zr Zirconium 40</div>		<div>93 Nb Niobium 41</div>		<div>96 Mo Molybdenum 42</div>		<div>99 Tc Technetium 43</div>		<div>101 Ru Ruthenium 44</div>		<div>103 Rh Rhodium 45</div>		<div>106 Pd Palladium 46</div>		<div>108 Ag Silver 47</div>		<div>112 Cd Cadmium 48</div>		<div>115 In Indium 49</div>		<div>119 Sn Tin 50</div>		<div>122 Sb Antimony 51</div>		<div>128 Te Tellurium 52</div>		<div>127 I Iodine 53</div>		<div>131 Xe Xenon 54</div>	
<div>133 Cs Caesium 55</div>		<div>137 Ba Barium 56</div>		<div>139 La Lanthanum 57</div>		<div>179 Hf Hafnium 72</div>		<div>181 Ta Tantalum 73</div>		<div>184 W Tungsten 74</div>		<div>186 Re Rhenium 75</div>		<div>190 Os Osmium 76</div>		<div>192 Ir Iridium 77</div>		<div>195 Pt Platinum 78</div>		<div>197 Au Gold 79</div>		<div>201 Hg Mercury 80</div>		<div>204 Tl Thallium 81</div>		<div>207 Pb Lead 82</div>		<div>209 Bi Bismuth 83</div>		<div>210 Po Polonium 84</div>		<div>210 At Astatine 85</div>		<div>222 Rn Radon 86</div>	
<div>223 Fr Francium 87</div>		<div>226 Ra Radium 88</div>		<div>227 Ac Actinium 89</div>																															

Key

Key

Ar

Symbol

Name

Z

relative atomic mass

atomic number